(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 793 166 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
03.09.1997 Bulletin 1997/36

(51) Int. Cl.[6]: **G06F 9/24**

(21) Application number: **96112464.1**

(22) Date of filing: **01.08.1996**

(84) Designated Contracting States:
DE FR GB IT

(30) Priority: **14.08.1995 JP 206863/95**
27.09.1995 JP 249226/95

(71) Applicant: **AISIN AW CO., LTD.**
Anjo-shi Aichi-ken 444-11 (JP)

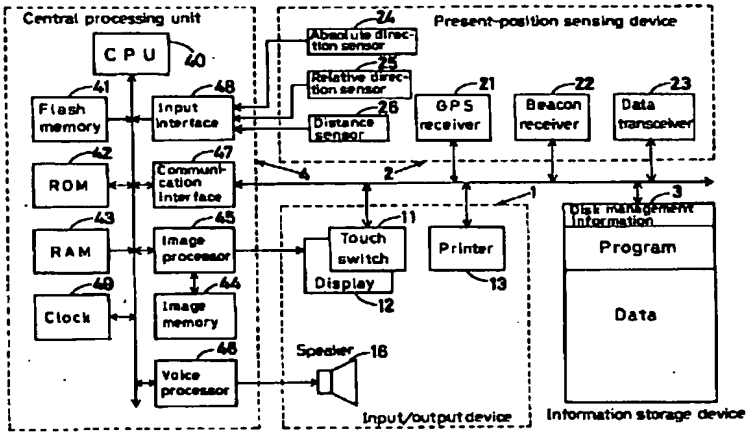
(72) Inventors:
- **Morimoto, Kyomi,**
c/o Aisin Aw Co., Ltd.
Fujii-cho, Anjo-shi, Aichi-ken 444-11 (JP)
- **Nimura, Mitsuhiro,**
c/o Aisin Aw Co., Ltd.
Fujii-cho, Anjo-shi, Aichi-ken 444-11 (JP)
- **Ito, Yasunobu,**
c/o Aisin Aw Co., Ltd.
Fujii-cho, Anjo-shi, Aichi-ken 444-11 (JP)

(74) Representative: **VOSSIUS & PARTNER**
Siebertstrasse 4
81675 München (DE)

(54) Navigation system and computer program loading therefor

(57) An external storage device 3 having navigation data and program stored therein to perform a route search and route guidance, and a central processing unit 4 which includes a program storage flash memory 41 and program loading means 42 for loading a program from external storage device 3 into flash memory 41 and in which the program stored in flash memory 41 is run to perform a route search and route guidance are provided. Central processing unit 4 compares a version of the program stored in flash memory 41 with a version of the program stored in external storage device 3, so that only when the version of the program stored in external storage device 3 is higher than that in flash memory 41, the program is loaded from external storage device 3 into flash memory 41.

FIG. 3



EP 0 793 166 A2

Description

The present invention relates to a navigation system for making a route search to preset destinations, thereby achieving route guidance.

Various navigation systems have been proposed to implement route guidance from departure or present positions to any desired destinations via transit points using screen displays and voice. As well known in the art, a typical vehicular navigation system is made up of an information storage device in which there are stored map data, guidance data for achieving route guidance as to geometrical features of intersecting points and locations to be passed by, using screen displays and voice. By input of the transit point and destination, a guidance route to the destination is searched out (route search), thereby achieving route guidance. For this reason, the vehicular navigation system includes an input/output device for inputting and outputting information about route guidance, a present-position sensing device for sensing the present position of the vehicle, an information storage device in which there are recorded the navigation data required for route calculation, the image and voice guidance data needed for route guidance, and the like, a central processing unit for performing search processing and the image guidance processing needed for route guidance as well as for performing control of the overall system, etc.

In general, an information storage device is a database which, as shown in Fig. 1 as an example, comprises files such as an index, map data, search data, guidance data, map matching data, and destination data, with all the data needed for a navigation system recorded therein. CD-ROMs are often used as practical recording media. The device also has an application section including navigation programs such as a map drawing subsection (a map drawing program), a route search subsection (a route search program), a route guidance subsection (a route guidance program), a present-position calculation subsection (a present-position calculation program) and a destination setting operation control subsection (a destination setting operation control program), and an operating system (OS) section. Given processing is performed using map data at the map drawing subsection, search data at the route search subsection, guidance data at the route guidance subsection, map matching data at the present-position calculation subsection, and destination data at the destination setting operation control subsection. It is here to be noted that at the present-position calculation subsection the calculation of the present position is performed using map data; that is, if the map data is used not only at the map drawing subsection but at the present-position calculation subsection as well, it is then possible to dispense with the map matching data, thereby reducing the whole quantity of data used.

At the present-position calculation subsection, direction information and distance information obtained in the form of signals from a relative direction sensor, an absolute direction sensor and a distance sensor are collated with the map data or map matching data to detect the present position. Given instructions for input of the intended point such as the destination and route search, the route search subsection uses the search data to make a search to find out the optimum route. Upon the startup of guidance following this, the route guidance subsection displays a map indicating in what direction the vehicle is to run from the present position, for instance. At the same time, the guidance data is used according to the found-out route to output in the form of screen displays and voice a variety of information about intersecting points, geometrical features of locations to be passed by, distances to transit points, and in what direction the vehicle is to turn at an intersecting point, thereby achieving route guidance.

A conventional vehicular navigation system is generally broken down into two types in terms of the manner of storing programs and data for performing a route search and route guidance. In one type as shown typically in Fig. 2B, only the data is stored in a CD-ROM while applications and OS programs are done in a central processing unit. In another type as shown in Fig. 2A, programs and data are stored in the CD-ROM, and are then sequentially loaded into a program memory space previously located in the central processing unit.

However, the system of the type having navigation programs and map data stored in the CD-ROM, wherein, upon launching, the navigation programs are loaded into the program memory space for the purpose of running them, takes much more time to start up or launch, when compared with the system of the type having navigation programs stored in the internal CD-ROM, because whenever the system is launched, the navigation programs are loaded into the program memory space.

All these types have programs and data of their own, and so are designed to perform a route search and route guidance of their own. For this reason, they are sophisticatedly different from each other not only in terms of route search algorithm and its results but in terms of how to achieve route guidance as well, for instance, how maps are displayed and present positions are expressed, and screen displays, voice information, and timing of intersecting points and geographical features. It is thus always required for a supplier to provide a central processing unit and CD-ROM in a set-up form. Once a user has purchased a certain system set up by a certain maker, on the other hand, it is always required for the user to use CD-ROMs of the same specification made by that maker. Referring here to a system A composed of a CD-ROM with program A and data A stored therein and a central processing unit, services rendered to the user are nothing else than those making use of the concepts behind a route search and route guidance dedicated to the system A; in other words, only a CD-ROM with program B and data B stored therein cannot be detached from a system B having that CD-ROM and a central processing unit for running on the system A

different conceptually from the system B. To update or complete maps, early users have to wait for software makers to develop appropriate applications, and if nothing is available to the users, they must somehow replace the central processing unit and CD-ROM by compatible ones.

One object of the present invention is to provide a navigation system which dispenses with extravagant operations when the power is turned on to reduce the time needed for launching a CD-ROM, so that it can be launched rapidly. Another object of the present invention is to provide a navigation system which enables CD-ROMs used on similar other systems to be selectively used therewith.

According to one aspect of the present invention, there is provided a navigation system designed to perform a route search to a destination and route guidance, which comprises an external storage device in which navigation data and program for performing said route search and said route guidance have been stored, and a central processing unit for running said program, thereby performing route search and guidance processing on the basis of said data, characterized in that:

said central processing unit includes nonvolatile memory means for storing said program and program loading means for loading said program from said external storage device into said nonvolatile memory means,

said program loaded from said external storage device into said nonvolatile memory means being run, and

said program loading means being designed to check up an update number of said program so that when said update number is older in said external storage means than in said nonvolatile memory means, a classification number of said program is checked up, and when said classification number differs between said external storage device and said nonvolatile memory means, said nonvolatile memory means is updated.

According to another aspect of the present invention, there is provided a navigation system designed to perform a route search to a destination and route guidance, which comprises an external storage device in which navigation data and a plurality of programs for performing said route search and said guidance have been stored, and a central processing unit for running said programs, thereby performing processing for route search and guidance on the basis of said data, characterized in that:

said central processing unit includes nonvolatile memory means for storing said programs and program loading means for loading said programs from said external storage device into said nonvolatile storage means, so that said programs loaded from said external storage device into said nonvolatile storage means can be run.

According to yet another aspect of the present invention, there is provided a memory medium used on a navigation system designed to perform a route search to a preset destination and route guidance in which there are stored navigation data and a plurality of programs for performing a route search to said preset destination and route guidance,

Still other objects and advantages of the invention will in part be obvious and will in part be apparent from the specification.

The invention accordingly comprises the features of construction, combinations of elements, and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the invention will be indicated in the claims.

Fig. 1 shown one exemplary structure of navigation data and program.

Fig. 2 is views showing how information stored in a CD-ROM used on a conventional vehicular navigation system corresponds to a central processing unit (ECU).

Fig. 3 is a block diagram showing one embodiment of a vehicular navigation system to which the present invention is applied.

Fig. 4 is a block diagram illustrating the flow of processing for program loading.

Fig. 5 is a block diagram illustrating the flow of processing for program version checking.

Fig. 6 shows one exemplary structure of CD-ROM data.

Fig. 7 shows the relationship between one exemplary CD-ROM structure and a loader program provided in a central processing unit.

Fig. 8 is a block diagram illustrating the flow of processing on a loader program.

Fig. 9 the relationship between another exemplary CD-ROM structure and a loader program provided in a central processing unit.

Fig. 10 is a block diagram illustrating the flow of processing on a loader program.

Fig. 11 is views showing how CD-ROMs and central processing units are mutually used.

Fig. 12 illustrates exemplary combinations of applications and operating systems stored in a CD-ROM.

As shown in Fig. 3, a vehicular navigation system according to the present invention comprises an input/output unit 1 for input/output of information about route guidance, a present-position sensor 2 for sensing information about the present position of an automotive vehicle, an information storage device 3 in which the navigation data necessary for route calculation and the screen display/voice guidance data necessary for route guidance, and a plurality of different types of programs (applications and/or OS) have been recorded, and a central processing unit 4 for executing route finding processing, the screen display/voice guidance processing necessary for a route search and route guidance, and control of the overall system.

Each of these components will first be explained.

The input/output unit 1 functions to enter designations, to allow a driver to instruct the central processing unit 4, at the volition of the driver, to execute navigation processing in such a manner that guidance information can be outputted by voice and/or a screen display when

required by the driver, and to print out processed data. As means for implementing these functions, an input section of the input/output unit has a touch switch 11 or other operating switch for entering a designation in the form of a telephone number or coordinates on a map, and for requesting route guidance. As a matter of course in this case, an input device such as a remote controller can be used to this end. An output section has a display 12 for displaying input data on a screen and, moreover, for automatically displaying route guidance on the screen in response to a request from the driver, a printer 13 for printing out data processed by the central processing unit 4 and stored in the information storage device 3, and a speaker 16 for outputting route guidance by voice.

It is here to be understood that additional provision may be made of a voice recognition device which enables voice input, and a card reader for reading data recorded on an IC card or magnetic card. It is also to be noted that in addition to these, provision may be made of a data communication device which exchanges data between an information center which enables the data needed for navigation to be stored therein and provided to a driver on demand via a communication line and an information source such as an electronic notebook with data specific to a driver, for instance, map or destination data previously stored in it.

The display 12 is built up of a color CRT or color liquid-crystal display device. On the basis of map data and guidance data processed by the central processing unit 4, the display 12 outputs, as a color display, all screens necessary for navigation, such as route setting screen, a screen of an interval view and a screen of intersections. The display 12 also display buttons for setting route guidance and for changing over guidance and screens during the route instruction. In particular, transit-intersection information such as the names of intersections to be traversed is displayed in color in the form of a pup-up menu on the interval view when required.

The display 12 is located within an instrument panel in the vicinity of a driver's seat. Observing displayed map enables the driver to make sure the present location of the vehicle and to obtain information regarding a route from this location. The display 12 is provided with a touch switch 11 that corresponds to the display of function buttons. The operations described above are executed based upon signals entered by touching the buttons. Input signal generating means constituted by the buttons and touch switch defines an input section, although any detailed description thereof is omitted.

The present-position sensing unit or sensor 2 has a GPS receiver 21 which makes use of a global positioning system (GPS), a beacon receiver 22, a data transceiver 23 for receiving a GP correction signal utilizing a cellular phone or FM multiplex signal, an absolute direction sensor 24 made up of a geomagnetic sensor or the like, a relative direction sensor 25 made up of a wheel sensor, a steering sensor, a gyro and so one, and a distance sensor 26 for detecting the distance traveled from the number of revolutions of wheels.

The information storage device 3 is an external storage device with a program and data for navigation stored in it, typically, a CD-ROM. The program comprises a map drawing section, a route search section, a route guidance section, a present-position calculation section, a designation setting operation control section, etc., and is made up of an application section for executing navigation signal output processing, an OS section and the like. Stored in this device are a program for performing route search and other processing, a program for performing the display output control needed for route guidance and the voice output control needed for voice guidance, and the data needed therefor, and the display information data needed for route guidance and map display. These data are composed of files on map data, search data, guidance data, map matching data, destination data, and the like, in which all the data needed for a navigation system are stored.

The central processing unit 4 includes a CPU 40 for executing various operations, a flash memory 41 into which the programs are loaded from the CD-ROM in the information storage device 3, a ROM 42 having therein a program (program loading means) for performing program checking and updating for the flash memory 41, a RAM 43 for provisionally storing the retrieved route guidance information on coordinates of the preset destination, roads' names, and code numbers, and data that are being operated, an image memory 44 in which image data used to produce screen displays is stored, an image processor 45 for fetching image data from the image memory 44 on the basis of a display output control signal from the CPU 40 and then subjecting it to image processing for screen displays, a voice processor 46 for compositing voice, phrases, single sentences and sounds read out of the information storage device 3 on the basis of a voice output control signal from the CPU into analog signals and then delivering them to the speaker 16, a communication interface 47 for exchanging input/output data by communication, a sensor input interface 48 for accepting sensor signals from the present-position sensor 2, a clock 49 for entering date and time into internal dialog information, and the like. Here, route guidance is performed via screen displays and voice output, and the driver may select whether or not voice output is produced.

As described above, the navigation system according to the present invention contains a built-in flash memory 41 of relative large capacity which loads programs from the external storage device or CD-ROM into memory, and a built-in ROM 42 of small capacity which has a CD startup or launching program (program loading means) stored therein. The flash memory 41 is a nonvolatile memory means designed to keep the stored information intact even upon the power going off. In launching the CD, the program of the program loading means or ROM 42 is started up to check up the programs stored in the flash memory 41, thereby loading disk management information and the like from the CD-

ROM of the information storage device 3 into memory. The program-loading (or updating) processing is conducted while this information and the state of the flash memory 41 are being judged. This processing will now be explained with reference to Fig. 4.

With the power put on, while the screen is held off (Step S11), the program is checked up as to whether or not it is normally loaded in the flash memory (Step S12). If the answer is "OK", the program stored in the flash memory is started up or launched (Step S13) to allow an opening screen to appear (Step S14). Then, the disk management information is loaded from the CD-ROM into memory (Step S15) to check up a program version from the program version number of the CD-ROM and the program version number stored in the flash memory (Step S16). Based on the comparison of these program versions, judgment is passed on whether or not the program is to be updated (Step S17). That is, if the program version of the CD-ROM is not upgraded with respect to that of the flash memory, the program of the flash memory is driven without being updated to display a map screen (Step S18). However, if the program version of the CD-ROM is upgraded, the upgraded screen is allowed to appear (Step S19), and the flash memory is cleared (Step S20) to get the system back to Step S12.

If the answer is "NG" at Step S12, the disk management information is loaded from the CD-ROM into memory (Step S21) to examine whether or not it is a dedicated disk (Step S22). If it is not a dedicated disk, then a guide message "INSERT A DEDICATED DISK" is displayed on the screen (Step S23). If it is a dedicated disk, the loader program is loaded from the CD-ROM into memory (Step S24) to start up the loader program (Step S25). Then, while a message "PROGRAM IS BEING LOADED" is displayed (Step S26), the navigation program is loaded (Step S27) from the CD-ROM into the flash memory (Step S28), so that the system can be restarted (Step S29) and brought back to Step S12. Where the program is thus properly loaded in the flash memory, the system can always be operated with the latest version of program by updating the program of the flash memory but with no loading of extravagant programs only when the program version on the CD-ROM is upgraded as compared with that on the flash memory. This is true of even when compatible CD-ROMs are set in the system.

At the version checking Steps S16 and S17, as shown in Fig. 5, the program versions in the flash memory and CD-ROM are compared with each other (Step S31) to examine whether or not the classification numbers are different from each other (Step S32). If no difference is found between the classification numbers, whether or not the update number in the flash memory is older than that in the CD-ROM is further examined (Step S33). If there is a difference between the classification numbers or if the update number in the flash memory is older than that in the CD-ROM although there is no difference between the classification numbers, the program is judged to be updated. If there is no difference between the classification numbers and the update number in the flash memory is not older than that in the CD-ROM, on the other hand, the program is decided to be not updated.

The CD-ROM data structure is made up of disk management information, loader program, and navigation program and data, as shown typically in Fig. 6. The disk management information has a collection of information on the type of CD-ROM (which is for navigation, music or video purposes, and which is for local or national purposes if it is for navigation purposes), on sight-seeing and leisure, and on genre, e.g., classification number and update number. If the navigation CD-ROM selected is for local purposes, a district can then be determined from coordinates of its area. As already noted, the navigation programs are an application section composed of a map drawing subsection, a route search subsection, a route guidance subsection, a present-position calculation subsection, a destination presetting control subsection, and the like, and for processing navigation output signals, and an OS section, and the data are map data, search data, guidance data, map matching data, destination data, and the like.

When a CD changer is used in combination with the program loading means, it is possible to achieve automatic CD exchanges as per exchange instructions. With a specific CD selected, the disk management information (disk label) is loaded from the CD into memory to judge the content of that disk management information to thereby select the CD to be driven. If the thus selected CD is a navigation CD, the aforesaid program memory is updated upon identification of the classification number and update (version) number of that CD.

The use of such a CD changer causes an exchange of CDs to occur more frequently than would be the case with a single CD player. For this reason, especially when the present invention is applied to a changer type of equipment involving frequent exchanges of CDs, effects due to the aforesaid reduction in the CD loading time are of great significance. It is to be noted, by the way, that several types of about 6 to 8 navigation, music and video CDs are selectively used and driven. Even in this case, only the navigation CD can be run promptly by loading the disk management information from it into memory. Furthermore, it is possible to update the program smoothly. The program on the flash memory is designed such that it can be updated only when specific conditions are satisfied in terms of classification and version; some considerable effect can be achieved on reducing the length of time needed to launch the CD.

A loader program is in itself designed to be stored as program loading means on the system proper. This is because it contains a program inevitable for CD loading. However, it is not always necessary to provide any program other than one for loading an address of a given region on the CD on the system proper. In the present invention, too, the CD may have a part of the loader program assigned thereto as program loading means.

By use of such a layout, it is possible to reduce the

memory capacity needed to store extravagant programs on the system proper. Usually, the function for drawing images that display how the program has been updated as the loader program is stored on the system proper. However, the degree of freedom in drawing images can be assured by allowing the CD to have this function. Images displayed so far in the art are nothing else than simple messages such as "THE VERSION IS BEING UPGRADED" by reason of memory capacity. According to the present invention, however, images such as landscape pictures or whatever is appropriate can be processed, while the version being upgraded, without causing any memory capacity increase on the system proper. Almost practically, the loader program is designed to work for launching (updating) alone; in other words, it is a not-always-needed program. Thus, the loader program is run upon stored on the RAM for launching, and can be erased except that time, so that the memory capacity on the system proper can be decreased.

According to the present invention, a certain CD-ROM may have a plurality of programs stored thereon, which can run on a plurality of systems. Upon the CD-ROM set up on one system, the corresponding program may be loaded into the flash memory. In what follows, reference will be made to a specific embodiment of the invention where a common CD-ROM can be used on a plurality of systems.

In a CD-ROM (information storage device) shown in Fig. 7, an address space is allocated such that an index is stored from an address d, a program A is stored from an address a, a program B is stored from an address b, and data (A) is stored from an address c. The index is made up of data address, data size, the number of programs, and program address information for each system. Then, the program address information for each system is made up of information about the corresponding system (e.g., A, B, ...), version, program address, and program size. In short, this index corresponds to the disk management information explained with reference to Fig. 6, and the corresponding system corresponds likewise to the classification number. The program A runs on a central processor of the corresponding system A upon loaded therein, while the program B runs on a central processor of the corresponding system B upon loaded therein. For both the programs data (A) for the system A are commonly used. In other words, the program B that can run on the system B is provided for the data (A) to enable navigation using the data (A) created for the system A to be implemented not only on the program A but for the system B as well.

Thus, if, corresponding to this CD-ROM, the loader program on the central processor (ECU) of the system A has a function of loading the index therein to recognize the address and size of the address A as program loading means, then the program A is loaded into program memory (the flash memory 41 shown in Fig. 3) upon the index loaded therein as shown in Fig. 7A. Thus, it is possible to implement route search or route guidance using the data (A) for the system A. Likewise, if the loader program on the central processor of the system B has a function of loading the index therein to recognize the address and size of the address B as program loading means, then the program B is loaded into program memory (the first RAM 42 shown in Fig. 3) upon the index loaded therein as shown in Fig. 7B. Thus, it is possible to implement route search or route guidance by the running of the program B on the system B, using the data (A) for the system A. It follows that the CD-ROM can be used in common to both the systems A and B. Accordingly, if the CD-ROM made up of the program A, program B and data (B) for the system B is used on the central processor of the system A, it is then possible to implement route search or route guidance by the running of the program A on the system A, using the data (B) for the system B.

Referring here to the processing performed on such a loader program as mentioned above, the CD-ROM is set in place as shown in Fig. 8 (Step S41). Upon the CD-ROM thus set in place, it loads the index from a given address d therein (Step S42) to retrieve a corresponding system from the program address for each system (Step S43). Whether or not there is the corresponding system (e.g., A) is then determined (Step S44). If any corresponding system is not found, a message to this effect is displayed on the screen (Step S45). If the corresponding system is found, then the version of the program is compared with that in the program memory (Step S46). If the version of the program is identical or lower in level with or than that in the program memory, then the program A in the program memory is immediately launched (Step S49). When the version of the program is at a higher level, however, the address, size and version of the program are stored in the program memory (Step S47), and a given size of the program A is loaded from a given address a into the program memory (Step S48). Thereupon, the program A in the program memory is launched (Step S49). By doing this, it is possible to dispense with extravagant steps S47 and S48 and, hence, achieve the prompt launching of the program when the version of the program is at the same level or at a lower level.

Shown in Fig. 9 is one exemplary structure of a CD-ROM with no index stored in it, which have programs A and B, each having a version and program size in the form of management information. In association with such a CD-ROM, a central processing unit has a loader program with a loading address preset therein. For instance, a loader program of the central processing unit of a system A loads a program A from an address a into memory, as shown typically in Fig. 9A. In this case, as shown typically in Fig. 10A, management information is first loaded into program memory, and the program is subsequently loaded into program memory according to the program size of that management information, so that the program A can be launched for navigation using data (A) of the system A. A central processing unit of a

system B has again a loader program for loading a program B from an address b into memory, as shown typically in Fig. 9B. In this case, management information is first loaded into program memory, and the program is subsequently loaded into program memory according to the program size of that management memory, as shown typically in Fig. 10B, so that the program B can be launched for navigation using data (A) of the system A. In such a layout, too, whether or not the program is to be updated may be decided by the comparison of the version in the management information with that in the program memory.

Fig. 11 shows how CD-ROMs and central processing units of systems A and B can be mutually used for each other. Fig. 11A illustrates an example of a CD-ROM storing data (A) of the system A as well as a program A running on the central processing unit of the system A and a program B running on the central processing unit of the system B, and Fig. 11B an example of a CD-ROM storing data (B) of the system B as well as a program A running on the central processing unit of the system A and a program B running on the central processing unit of the system B.

Thus, the central processing unit includes a loader program and program memory, said loader program serving as program loading means for loading a program of its own from the CD-ROM into memory. Stored in the CD-ROM are programs A and B for systems A and B, which are composed of an application section comprising a map drawing subsection, a route search subsection, a route guidance subsection, a present-position calculation subsection and a destination setting control subsection and an OS section, and all the data comprising files on a collection of data commonly used with these programs such as map data, search data, guidance data, map matching data, and destination data, and needed to run navigation systems. Thus, a single CD-ROM can be commonly used on different navigation systems, so that their availability and flexibility can be enhanced.

It is here to be noted that the present invention is not limited to the aforesaid embodiments, and so many modification or changes may be made thereto. For instance, the aforesaid embodiments make use of CD-ROMs for information (external) storage devices, but any desired detachable small information storage media, typically, memory cards and optical cards may be used as well. Programs compatible with different navigation systems are provided by a combined application and OS section set. This set may be divided into a common application section and a plurality of OS sections largely dependent on hardware, with which a plurality of programs are bundled. The aforesaid embodiments have been described with reference to navigation systems for route guidance. However, it is to be understood that the present invention may be applied as well to a navigation system having no route guidance function such as a location navigation system, and other systems such as a map information display system.

Reference will now be made to some modified combinations of application and OS sections to be stored in a CD-ROM, which are available for different systems. As shown typically in Fig. 12A, an OS section may be stored in the CD-ROM such that it is divided into not only a subsection commonly available for the systems A and B, but also subsections dedicated to the systems A and B. This enables storage capacity to be smaller than would be possible in the case of separately provided OS sections. For application to different host systems, e.g., for application to models A and B of a certain host system as shown in Fig. 12B, both application and OS sections may be divided into subsections dedicated to A and B. Alternatively, the application section may be dedicated in common to A and B. Still alternatively, the OS section may be divided into a subsection common to A and B, and subsections dedicated to A and B, respectively, as is the case with Fig. 12A. It follows that these combinations may be changed at a user's will.

In the aforesaid embodiments, a flash memory (a flash EEPROM) has been used as nonvolatile memory means (PROM) for storing programs therein. However, other desired storage means, e.g., EPROMs and EEPROMs may be used as well, if they can write over programs for specific purposes. The nonvolatile storage means used need not always be ROMs, and so RAMs may be used if they are nonvolatile.

In the present invention, EEPROMs or flash EEPROMs or electrically writable-over nonvolatile storage means are used so that programs can be written over while the storage means remains fixed in the system proper. This enables programs to be written over very easily. If the CD is allowed to have some part of the loader program as embodied above, then the updating of the program can be executed in byte unit, in given block unit or at full bits, because the updating range can be assigned thereto in the form of a program. Therefore, such as when a part of programs is changed, that part alone can be erased and updated so that the updating time of programs can be made short.

As can be appreciated from the foregoing, the present invention dispenses with extravagant updating of the CD-ROM programs and so enables the CD launching time to be made short, because upon programs loaded from the CD-ROM with navigation programs and data stored in it into nonvolatile storage means such as a flash memory, it is only when the program version of the CD-ROM is found by comparison to be higher than that of the storage memory that the programs loaded into the flash memory are updated.

Even when use is made of a CD-ROM with a combined navigation program and map data set stored in it, which is older than the flash memory in terms of the programs stored, the programs can be used without being updated, if the map data is compatible. Thus, even when local and national CDs are selectively used, navigation can be achieved on the latest program, with no need of putting the versions in order. Even when equip-

ment involving frequent exchanges of CDs such as a CD changer is used, it is also possible to reduce the number of updating (loading).

The loader program is to load a navigation program into memory, and so is not needed while the navigation program is running; it is stored in a CD-ROM, and is used to load map data therefrom into map data memory, which is designed to run on the navigation program alone, so that the memory (ROM) capacity of the system proper can be saved. Consequently, it is possible to change the design of a screen display showing how the program is being loaded into memory for each CD-ROM without any increase in the memory capacity of the system proper.

In addition, if a navigation program compatible with a plurality of different systems, map information for a route search and route guidance, and other route information are stored in an information storage device, a single CD-ROM (an information storage device) is then commonly available for systems having given navigation programs stored therein. Moreover, since a CD-ROM having given navigation programs stored therein can be used for other systems with no replacement of the central processing unit, a variety of navigation services can be rendered to users.

In some cases, even central processing units (ECUs) produced by the same maker should be modified to better their function and performance. Even in such cases, the present invention makes it possible to improve productivity because what is needed is only to produce a single type of CD-ROMs, whereas it was so far required to produce separate types of CD-ROMs.

Claims

1. A navigation system designed to perform a route search to a destination and route guidance, which comprises an external storage device in which navigation data and program for performing said route search and said route guidance have been stored, and a central processing unit for running said program, thereby performing said route search and said route guidance on the basis of said data, characterized in that:

   said central processing unit includes nonvolatile memory means for storing said program, and program loading means for loading said program from said external storage device into said nonvolatile memory means, so that said program loaded from said external storage device into said nonvolatile memory means is run.

2. The navigation system according to Claim 1, characterized in that:

   said program loading means is designed such that when the program stored in said external storage device is to carry out navigation and is different from the program stored in said nonvolatile memory means, said first-mentioned program is loaded from said external storage device into said nonvolatile memory means for updating.

3. The navigation system according to Claim 1 or 2, characterized in that;

   said program loading means loads management information from said external storage means into memory, so that if said management information is to perform navigation, a classification number and an update number as to whether the goal of said navigation is local navigation, national navigation or sight-seeing are compared with the program stored in said nonvolatile memory means to update said non-volatile memory means.

4. The navigation system according to Claim 3, characterized in that:

   said program loading means is designed to check up a program update number, so that when said update number is older in said nonvolatile memory means than in said external storage device, said nonvolatile memory means is updated.

5. The navigation system according to Claim 3 or 4, characterized in that:

   said program loading means is designed to check up a program classification number, so that when said classification number differs between said external storage device and said nonvolatile memory means, said nonvolatile memory means is updated.

6. The system according to any one of claims 1 to 5, characterized in that:

   said external storage device stores a loader program, and a navigation program and data, and said program loading means loads said loader program from said external storage device into memory so that said navigation program is updated by said loader program.

7. The system according to any one of claims 1 to 6, characterized in that:

   said external storage device includes a plurality of disks, and a disk changer for making an exchange of said plurality of disks in response to a selection signal for loading into memory.

8. A navigation system designed to perform a route search to a destination and route guidance, which comprises an external storage device in which navigation data and a plurality of programs for performing said route search and said route guidance have been stored, and a central processing unit for running said program, thereby performing said route search and said route guidance on the basis of said data, characterized in that:

   said central processing unit includes nonvolatile memory means for storing said programs, and

program loading means for loading said programs from said external storage device into said nonvolatile memory means, so that said program loaded from said external storage device into said nonvolatile memory means is run.

9. The navigation system according to Claim 8, characterized in that:

said plurality of programs are compatible with different types of navigation systems, and said program loading means retrieves a program compatible with a given corresponding type of navigation system from said external storage device into memory.

10. The navigation system according to Claim 8 or 9, characterized in that:

said external storage device has a collection of index information including information about a given corresponding type of navigation system, and a program address and program size thereof, and said program loading means retrieves said corresponding type of navigation system from said index information for loading a corresponding program into memory.

11. The navigation system according to Claim 8, 9 or 10, characterized in that:

said external storage device has version information for each of programs compatible with different types of navigation systems, and said program loading means of said central processing unit compares a program and version stored in said program storage means, so that only when there is a difference therebetween, said program is loaded into memory.

12. The system according to any one of claims 8 to 11, characterized in that:

said external storage means has an address specific to each corresponding type of navigation system assigned to said plurality of programs, and said program loading means has a preset loading address specific to said corresponding type of navigation system and loads a program compatible with said corresponding type of navigation system from said external storage device into memory.

13. The system according to any one of claims 8 to 12, characterized in that:

said navigation data includes a collection of map data, search data, guidance data, and destination date.

14. The system according to any one of claims 8 to 13, characterized in that:

said plurality of programs include a collection of map drawing program, route search program, route guidance program, present-position calculation program, and destination setting control program.

15. The system according to any one of claims 8 to 14, characterized in that:

said plurality of programs have programs differing between the types of navigation systems and a program common to the types of navigation systems stored therein along with address information for each program.

16. A memory medium used on a navigation system designed to perform a route search to a preset destination and route guidance, characterized in that:

navigation data and a plurality of programs for performing a route search to said preset destination and the thus searched route guidance are stored therein.

17. The memory medium according to Claim 16, characterized in that:

said navigation data includes a collection of map data, search data, guidance data, and destination date.

18. The memory medium according to Claim 16 or 17, characterized in that:

said plurality of programs are compatible with different types of navigation systems.

19. The memory medium according to Claim 16, 17 or 18, characterized in that:

said plurality of programs include a collection of map drawing program, route search program, route guidance program, present-position calculation program, and destination setting control program.

20. The system according to any one of claims 16 to 19, characterized in that:

said plurality of programs have programs differing between the types of navigation systems and a program common to the types of navigation systems stored therein along with address information for each program.

FIG. 1

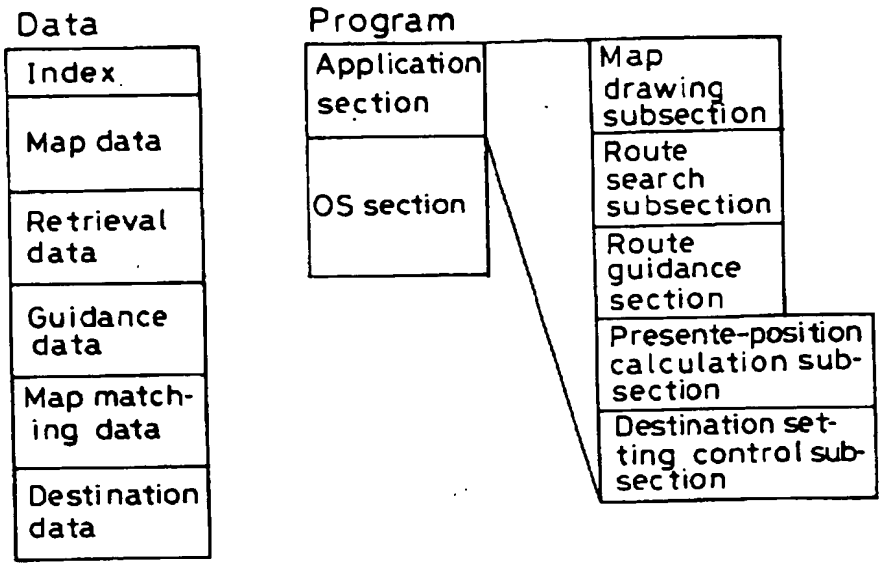


FIG. 2A

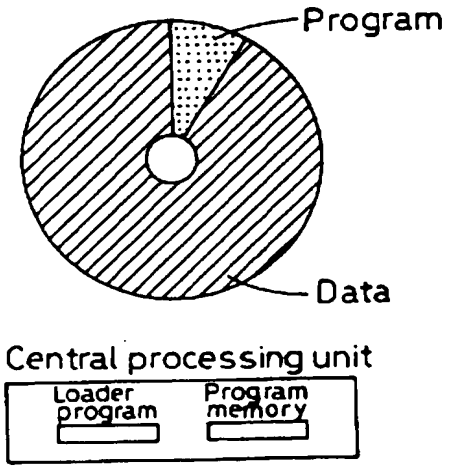


FIG. 2B

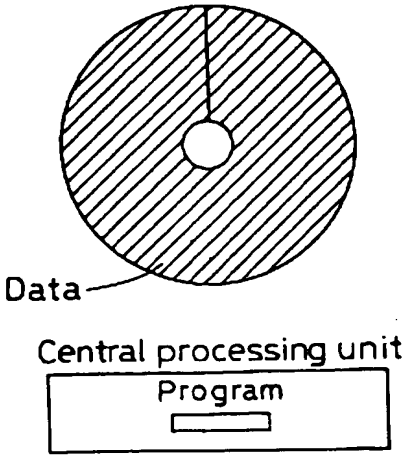


FIG. 3

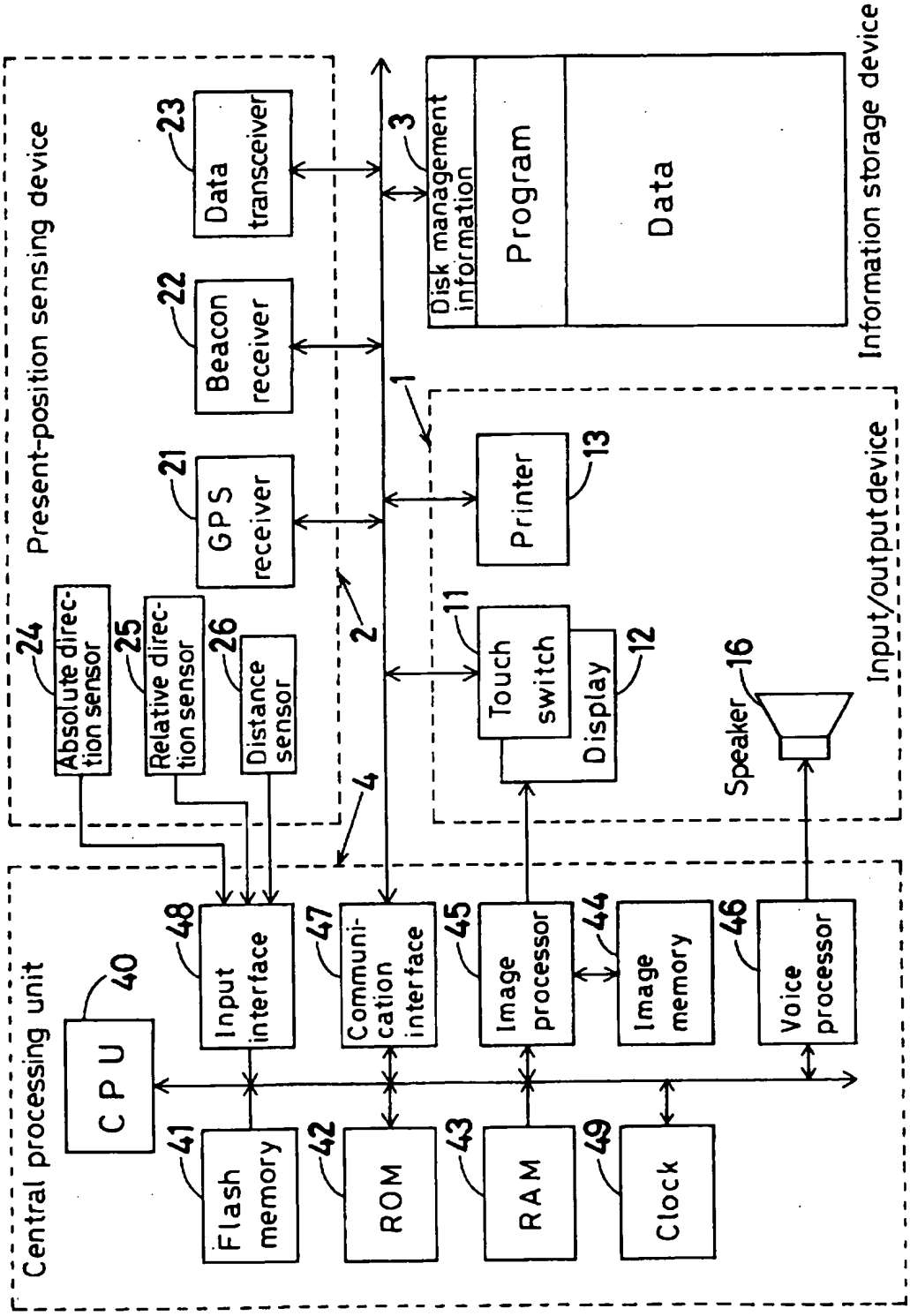

Present-position sensing device
Absolute direction sensor
24
Relative direction sensor
25
Distance sensor
26
GPS receiver
21
Beacon receiver
22
Data transceiver
23
2
4
1
3
Disk management information
Program
Data
Information storage device
Printer
13
Touch switch
11
Display
12
Speaker
16
Input/output device
Central processing unit
CPU
40
Input interface
48
Communication interface
47
Image processor
45
Image memory
44
Voice processor
46
Flash memory
41
ROM
42
RAM
43
Clock
49

FIG. 4

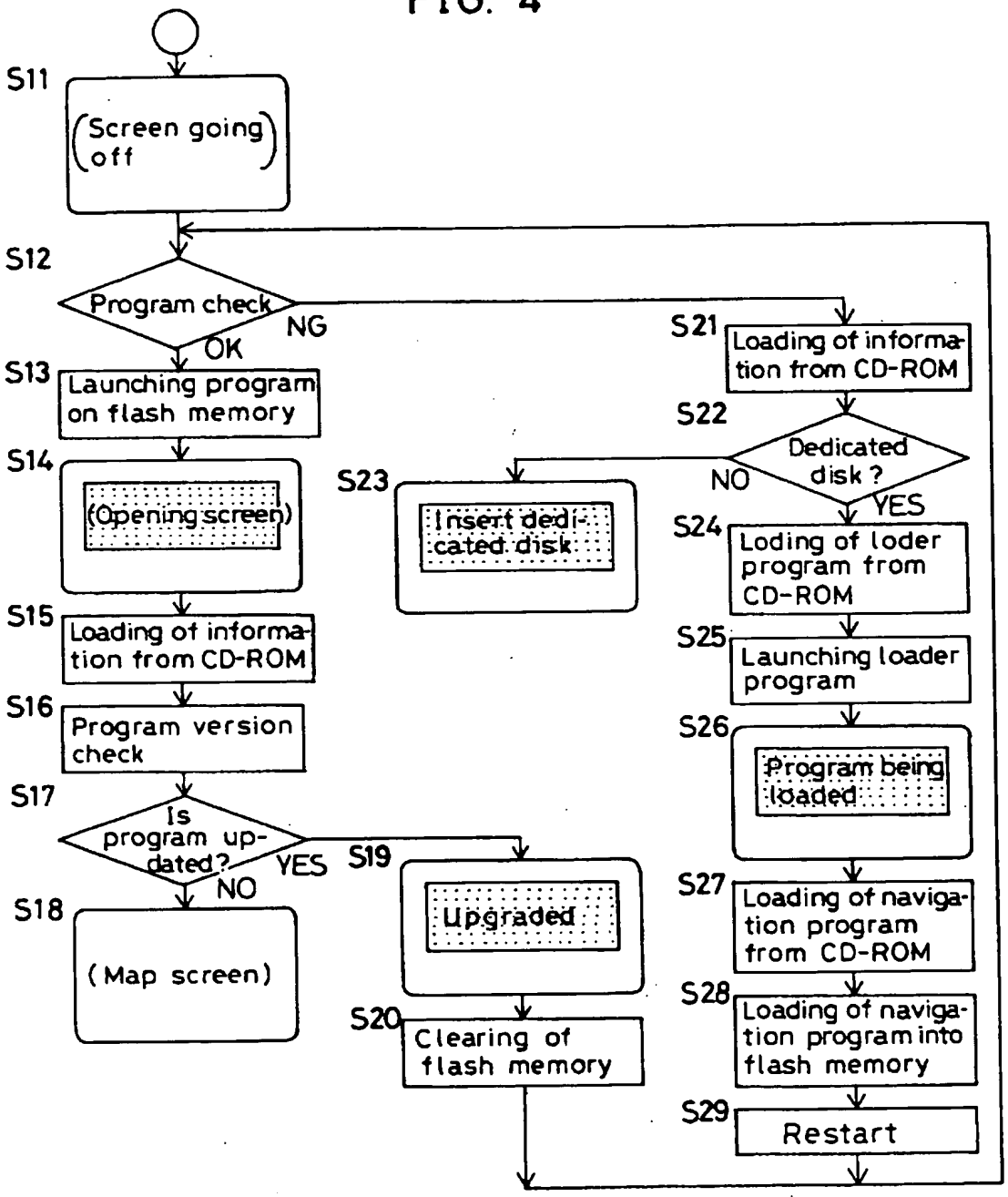

S11
(Screen going off)
S12
Program check
NG
OK
S13
Launching program on flash memory
S14
(Opening screen)
S15
Loading of information from CD-ROM
S16
Program version check
S17
Is program updated?
YES
NO
S18
(Map screen)
S19
Upgraded
S20
Clearing of flash memory
S21
Loading of information from CD-ROM
S22
Dedicated disk ?
NO
YES
S23
Insert dedicated disk
S24
Loding of loder program from CD-ROM
S25
Launching loader program
S26
Program being loaded
S27
Loading of navigation program from CD-ROM
S28
Loading of navigation program into flash memory
S29
Restart

FIG. 5

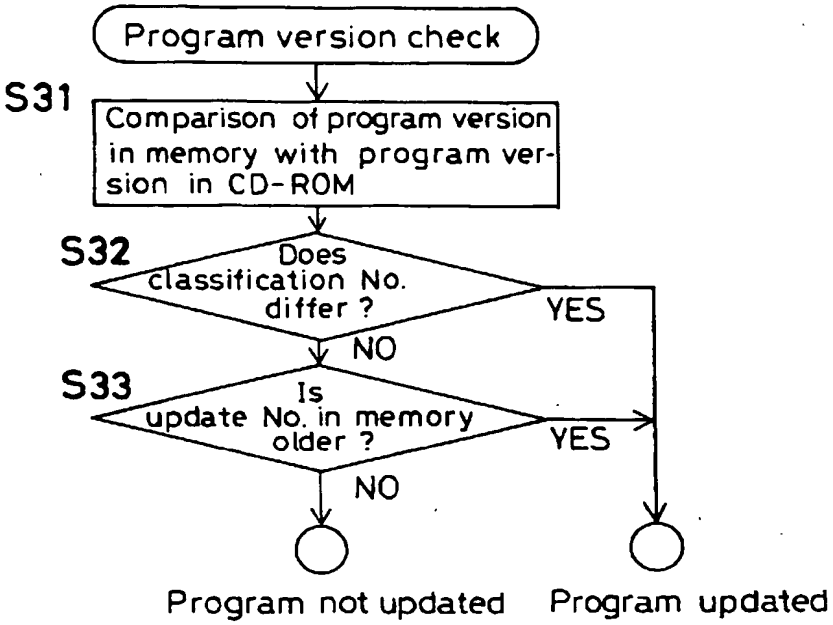

Program version check
S31
Comparison of program version in memory with program version in CD-ROM
S32
Does classification No. differ ?
YES
NO
S33
Is update No. in memory older ?
YES
NO
Program not updated
Program updated

FIG. 6

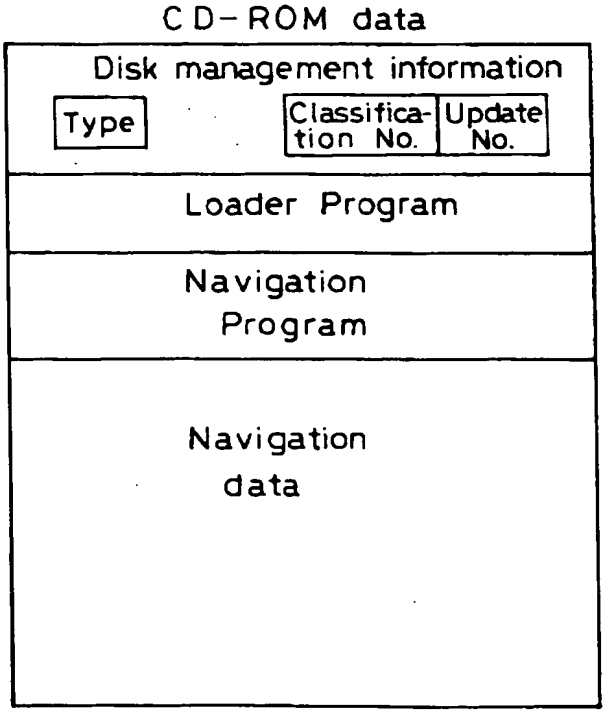

CD-ROM data
Disk management information
Type
Classification No.
Update No.
Loader Program
Navigation Program
Navigation data

FIG. 7A

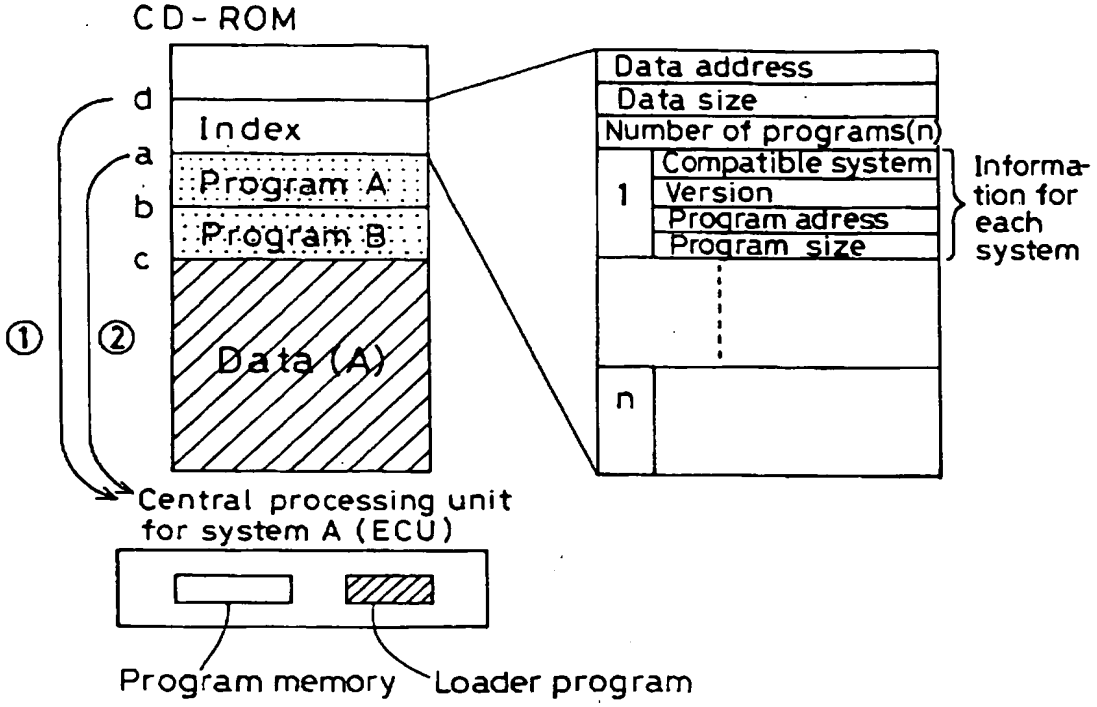

CD-ROM
d
Index
a
Program A
b
Program B
c
Data (A)
①
②
Data address
Data size
Number of programs(n)
1
Compatible system
Version
Program adress
Program size
Information for each system
n
Central processing unit for system A (ECU)
Program memory
Loader program

FIG. 7B

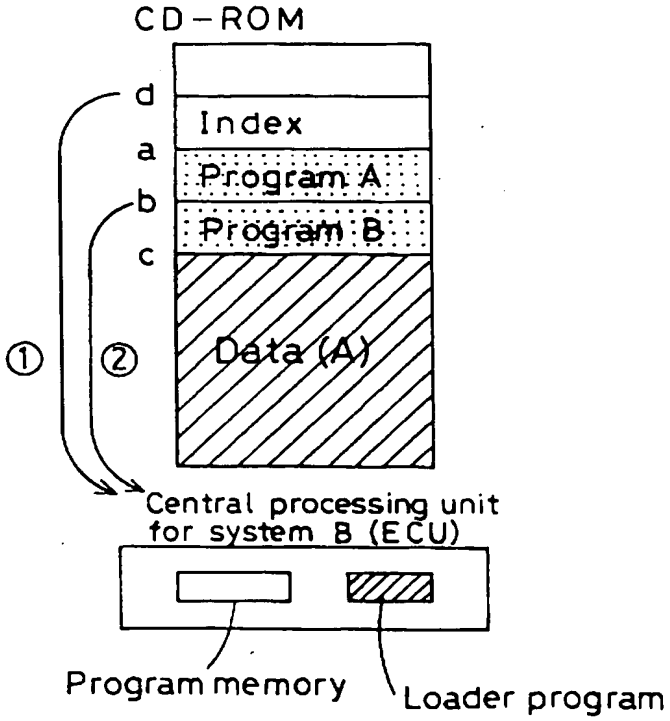

CD-ROM
d
Index
a
Program A
b
Program B
c
Data (A)
①
②
Central processing unit for system B (ECU)
Program memory
Loader program

FIG. 8

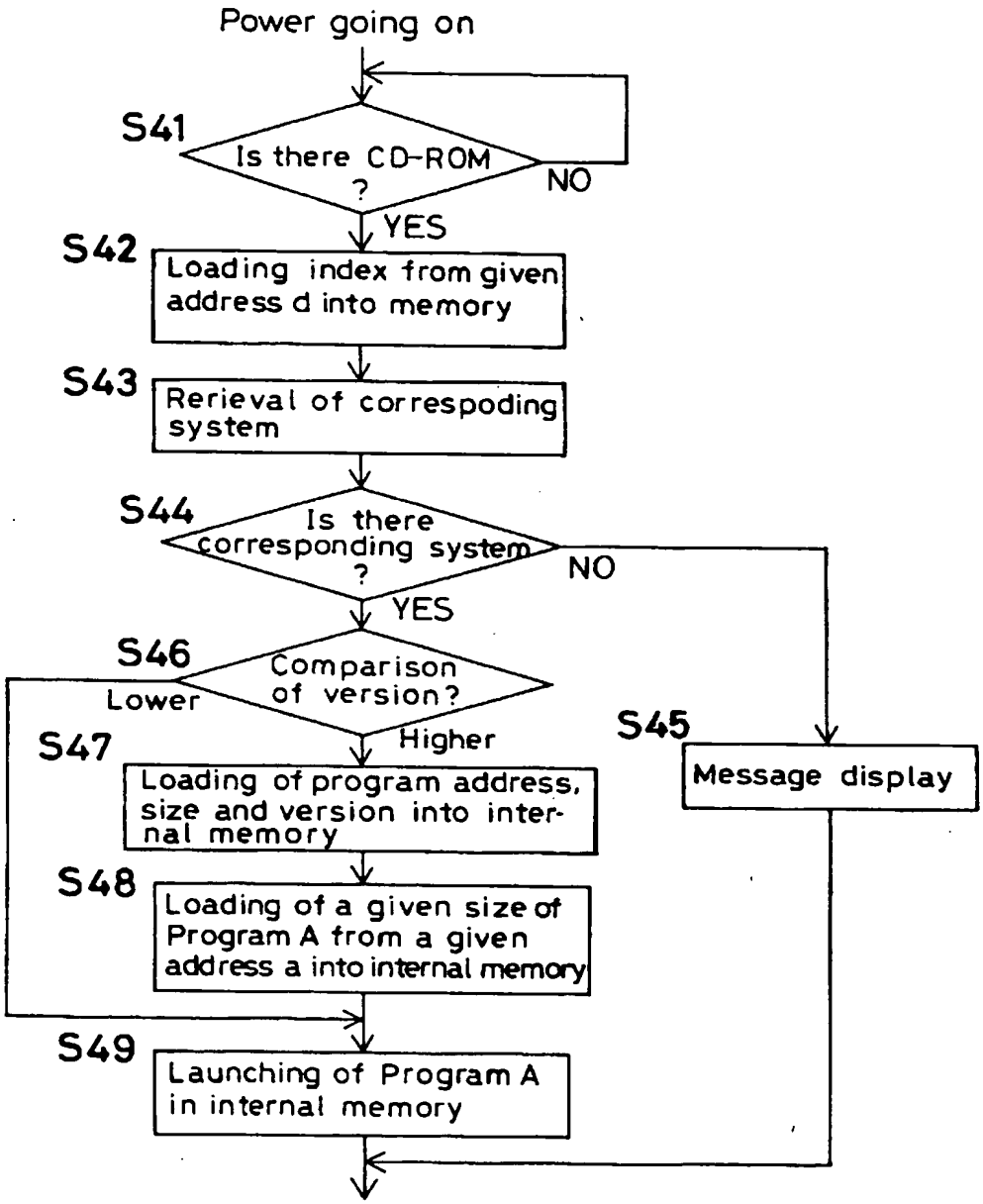

Power going on
S41
Is there CD-ROM ?
NO
YES
S42
Loading index from given address d into memory
S43
Rerieval of correspoding system
S44
Is there corresponding system ?
NO
YES
S46
Comparison of version?
Lower
Higher
S47
Loading of program address, size and version into internal memory
S48
Loading of a given size of Program A from a given address a into internal memory
S49
Launching of Program A in internal memory
S45
Message display

FIG. 9A

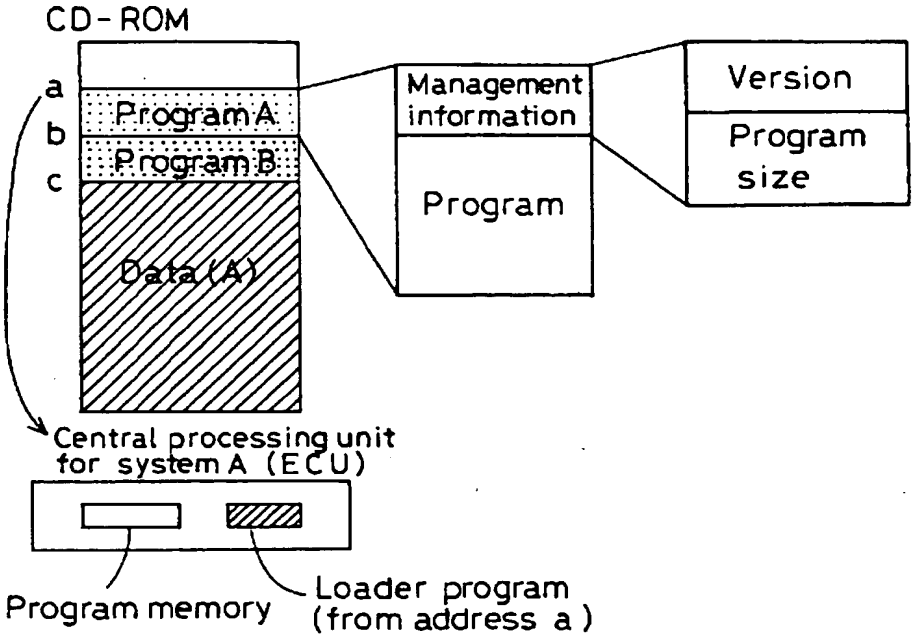

CD-ROM
a
b
c
Program A
Program B
Data (A)
Management information
Program
Version
Program size
Central processing unit for system A (ECU)
Program memory
Loader program (from address a)

FIG. 9B

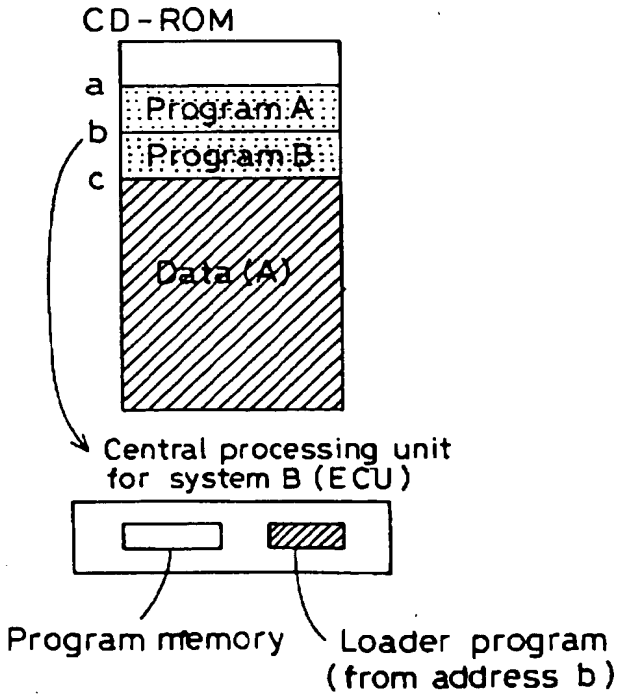

CD-ROM
a
b
c
Program A
Program B
Data (A)
Central processing unit for system B (ECU)
Program memory
Loader program (from address b)

FIG. 10A

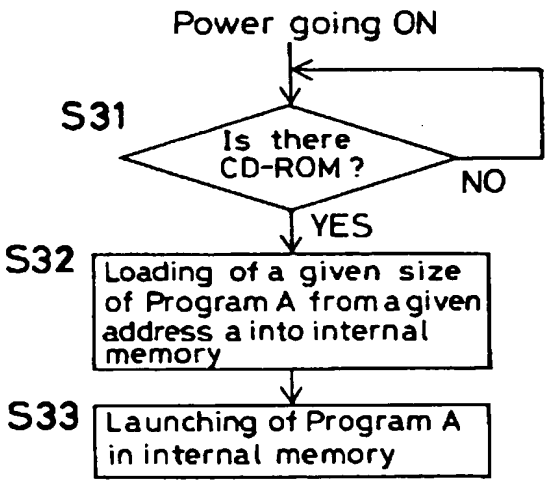


FIG. 10B

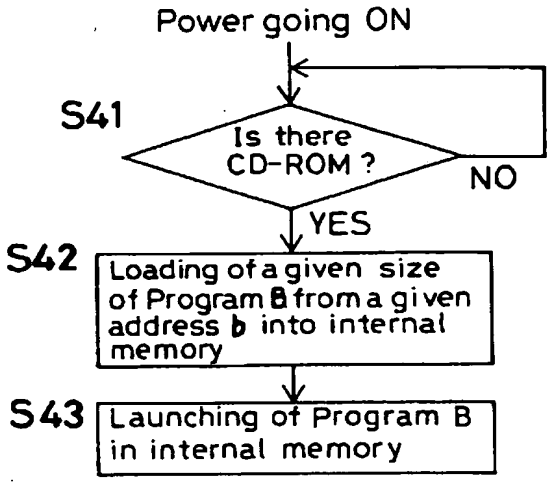


FIG.11A

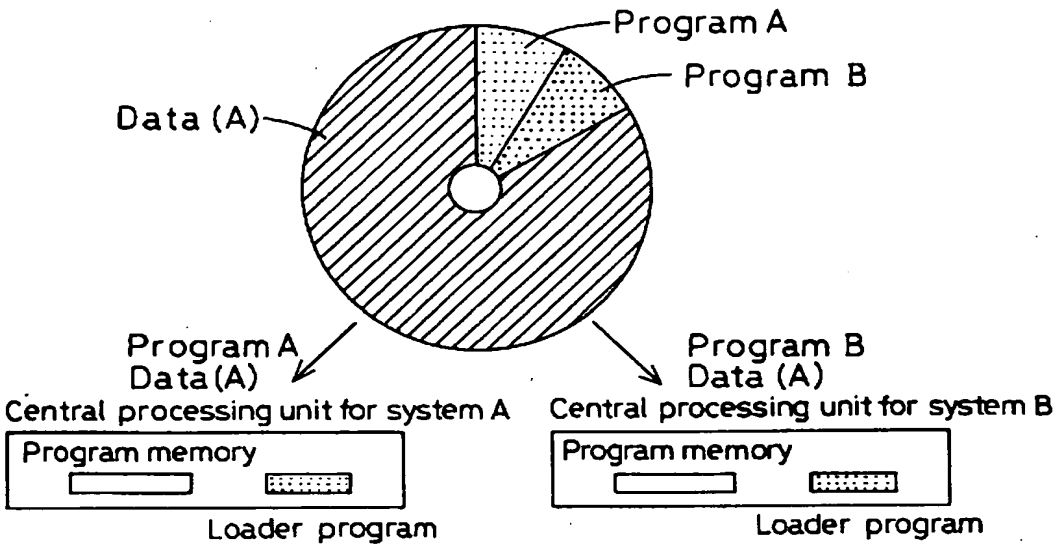


FIG.11B

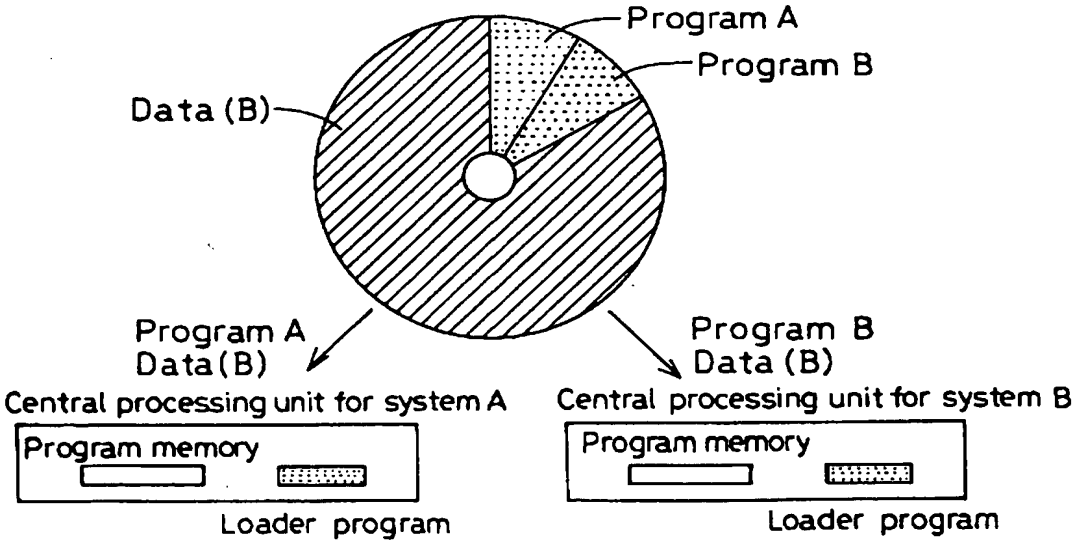


FIG. 12A

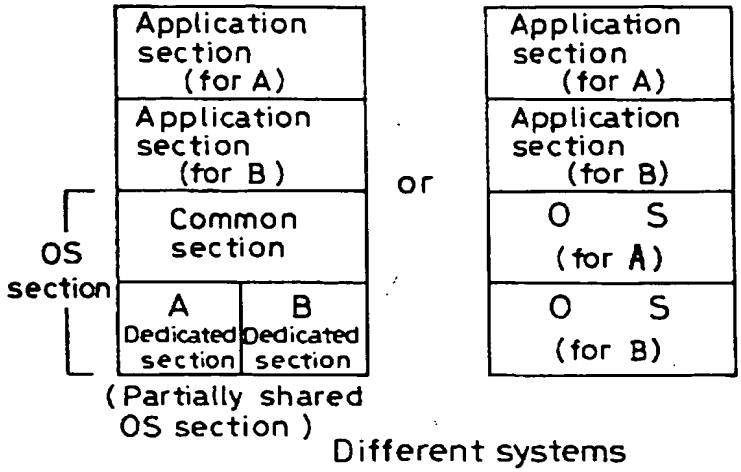


FIG. 12B